M01 RAW SYSTEM WIRING
06-18-07

This document, originally written by Ross Doyle back in the 1980s, is supplied for reference only. Much of the information contained in its pages is obsolete, fragmented or just flat wrong. For electronic service information refer to the most recent schematic drawings dated June 2007 and drawn by Daniel Schoo.

The updated drawings were the result of a careful investigation of the M01 RAW water control system as found. As such some things do not seem to make sense. You would be correct in that assumption. Many of the circuits were never implemented, removed or changed with little attention to professional practice. Some parts have no purpose and other parts are missing.

The drawings were not intended to improve the system but to document it as it is and to facilitate repairing it when it failed.

Daniel Schoo

MO1 RAW WIRING

12/15/86

Rev. 11/14/89

M01 RAW SYSTEM OPERATION

Rev. 11/14/89

This is a totally new type of Closed Loop Water Cooling system designed for the ease of replacement, repair, uniformity, portability, computer readouts, and variable flow rates. This system has the rated capacity of 150 KW. and flow rates from 5 g.p.m. to 60 g.p.m., with a constant pressure of 115 p.s.i. and is known as the RAW System (radioactive water).

Incorporated in this system is the following;
Where the loads required cooling water at a lower temperature or have the max. load of 150 KW. we have installed an ICW heat exchanger that precools the LCW to a lower temperature, this portion of the system is not used. This eliminates the need for costly and complicated chillers that have been used in the past. This system does require the LCW cooling to satisfy the Radiation Safety Group, but not the ICW. The surge tank in this system is open to the atmosphere to release any hydrogen build-up that may occur and eliminates the need for recombiners and extra alarms. The RAW system has two temperature readouts and one flow readout, these are analog readouts and may be processed by the main computer system. There are (13) status points that are available from these systems along with the (3) analog points. These status points will indicate if a pump is operating, if the flow is proper, if the temperature is ok, if the surge tank is at the proper level, ect.. This system had many other interlocks and status points but they have been jumpier because the chiller was never required.

The reason for having a semi-portable system with extra interlocks and status readouts, is to try and eliminate the "Johnson Control Syndrome" that all departments were chained to in the past. This system was the prototype for all of the new RAW systems and is not identical with all of the other RAW systems.

The main control box for this system is located in MS-1 for a visual readout of the system that it is operating. The front face of the control box is diagramed to give the operator a flow diagram of the system, and indicates the proper flows and temperatures. The lights on the front of the control box give the operator an instant look at the system, if the lights are green then the system is ok, if red other than the spare pump or the lights that indicate that they are jumpered, then there is a problem.

System Operation

Raw water from the pump is pushed to the load of the system. The RAW water removes the heat build-up from the load and returns through the LCW to RAW heat exchanger to remove the heat. After the LCW to RAW heat exchanger the RAW water is returned to the suction side of the RAW pump. The supply and return temperatures, and flow is monitored in this loop. LCW from the main LCW system enters the ICW to LCW heat exchanger through the LCW flow regulator (adj. from 10-60 g.p.m.) this precools the LCW if required. After the ICW to LCW heat exchanger the LCW enters the LCW to RAW heat exchanger removing the heat from the RAW water and then returns to the main LCW system. All RAW systems require LCW cooling and are interlocked with the LCW flow switch. If precooling is required, then the system is interlocked with the ICW flow or pressure switch.

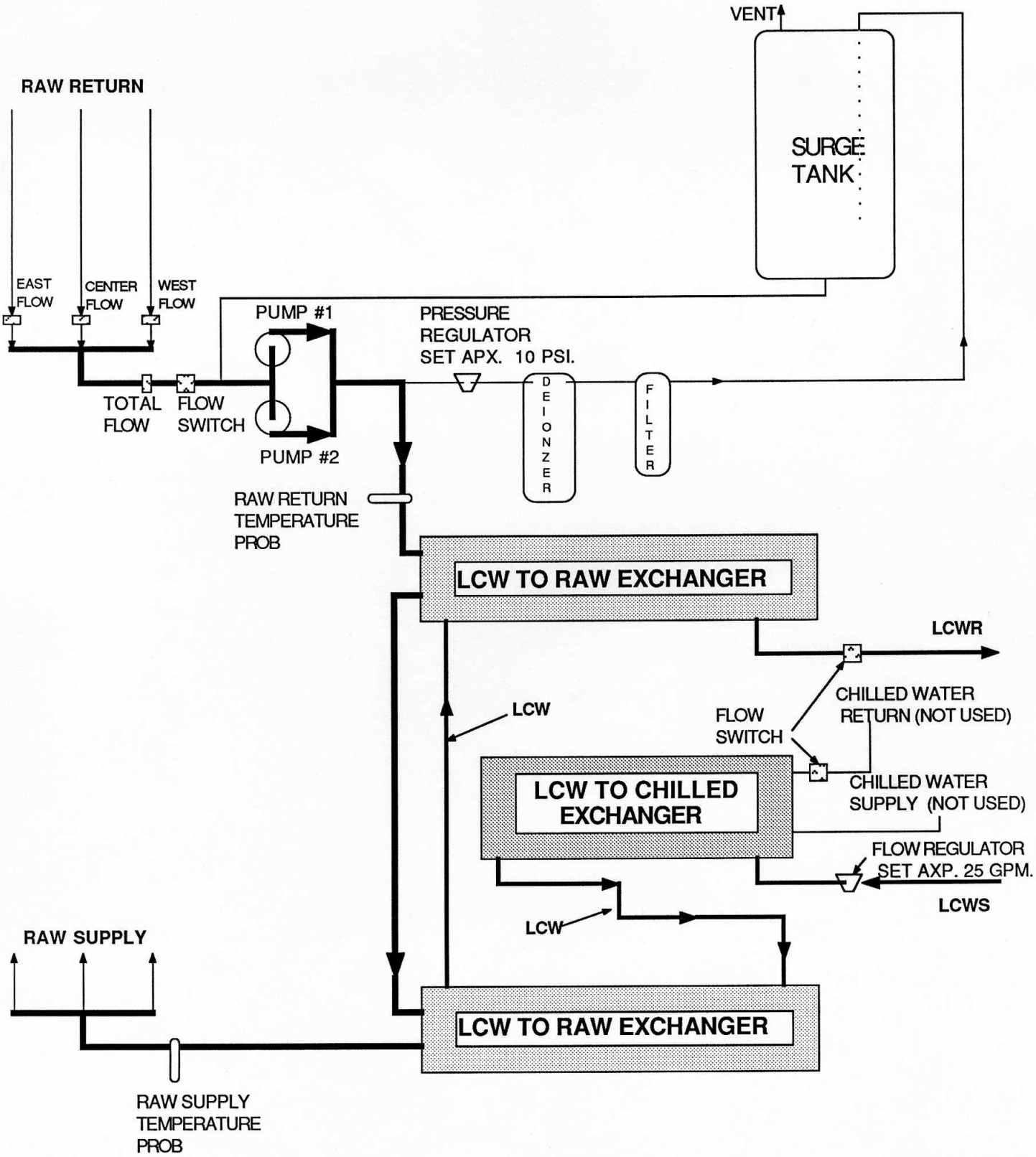
Apx. 5 g.p.m. of the RAW water is pushed through the deionizing loop at a pressure of 10 p.s.i. then through the string filter and back to the surge tank. When the water is made-up it passes through the deionizing loop and filter before entering the surge tank. To change the deionizing bottle or filter the system must be off. The valves on the deionizing loop must be closed. To make-up water manually close the 3/4" valve before the deionizing loop, pressure regulator. Open the valve marked make-up. Fill the surge tank 3" from the top of the sight glass. Close the make-up valve. Reopen the 3/4" valve before the pressure regulator.

To start a system, select pump #1 or pump #2. The valves for the selected pump must be open and closed for the other. Check that the surge tank normal. Check that the LCW flow is OK. Push the start and the reset button, until the RAW total flow light changes from red to green, release the start and reset button. All lights should be green except for the spare pump and the readouts that are jumpered. The flow set point is indicated by tape on the flow indication meter.

The temperature is read by panel meters in degrees Celsius. The supply temperature will trip the system if the temperature exceeds the trip point. The return temperature will only send an alarm. The set point may be checked by rotating the knob or the front of the control box from actual to set. The temperature is now set at 49 deg c.= 120 f. This may change due to different loads.

MO1 RAW

Rev. 11/14/89



MO1 RAW COMPONENT LOCATIONS

ORIGINAL BY RED 11/11/81

BY RED 12/3/86
Rev. 11/13/89

LCW FLOW	WEST FLOW	CENTER FLOW	EAST FLOW	TOTAL FLOW	TOTAL FLOW	RAW PRESSURE	LOW SURGE TANK	HIGH SURGE TANK	RAW TEMP SUPPLY
K1	K2	JUMPERED K3	JUMPERED K4	K5	K6	JUMPERED K7	K8	K9	K10

TOTAL INTERLOCK CHAIN

RAW PUMP #1	RAW PUMP #2	CHILLER PUMP #1	CHILLER PUMP #2	CHILLER FLOW
K11	K12	NOT USED K13	NOT USED K14	NOT USED K15

NOTE: MANY OF THESE RELAYS AND OTHER CONNECTIONS HAVE BEEN JUMPERED DUE TO THE REMOVAL OF THE CHILLER SYSTEM, SEVERAL TEMPERATURE AND FLOW PROBS HAVE ALSO BEEN REMOVED.

RAW TEMP RETURN	WEST TEMP	CENTER TEMP	EAST TEMP	LCW SUPPLY TEMP	LCW RETURN TEMP	CHILLER TEMP	~~SYSTEM SUMATION~~	SPARE	SPARE
K16	NOT USED K17	NOT USED K18	NOT USED K19	NOT USED K20	NOT USED K21	NOT USED K22	K23	K24	K25

TEMPERATURE INTERLOCK

SOLID STATE RELAY #1
SURGE TANK HIGH

SOLID STATE RELAY #2
SURGE TANK LOW

A B C D E F G H I J K L
SUPPLY TEMPERATURE BOARD
1 2 3 4 5 6 7 8 9 10

A B C D E F G H I J K L
RETURN TEMPERATURE BOARD
1 2 3 4 5 6 7 8 9 10

LETTERS NEXT TO AMP STRIP CONNECTIONS ARE REMOTE PIN OUTS

LCW FLOW		PUMP #2 COIL	
WEST FLOW		24 VAC COM	
CENTER FLOW		PUMP #1 COIL	
EAST FLOW		CHILLER PUMP #2	
TOTAL FLOW		24 VAC COM	
SYS PRESS		CHILLER PUMP #1	
SUP TEMP TO TRAIN		CHILLER FLOW	
HIGH TANK		CHILLER #2	
HIGH TANK		CHILLER #1	
LOW TANK		RAW #2	
LOW TANK		RAW #1	
+5			
COM 5		START	
24+			
COM 24		STOP	

+/- 15 VDC POWER SUPPLY

+ 5 VDC POWER SUPPLY

FUSE

8 24 VAC OUT

11 24 VAC OUT

TRANSFORMER

1 AC IN

6 AC IN

	K12-9 RAW PUMP #2	69 T
	K12-5 RAW PUMP #2	70 U
	K13-9 CHILLER PUMP #1	71 V
	K13-5 CHILLER PUMP #1	72 W
	K14-9 CHILLER PUMP #2	73 X
	K14-5 CHILLER PUMP #2	74 Y
	K15-9 CHILLER FLOW	75 Z
	K15-5 CHILLER FLOW	76 a
	K16-9 RAW RETURN TEMP	77 b
	K16-5 RAW RETURN TEMP	78 c
	K17-9 WEST TEMPERATURE	79 d
	K17-5 WEST TEMPERATURE	80 e
	K18-9 CENTER TEMPERATURE	81 f
	K18-5 CENTER TEMPERATURE	82 g
	K19-9 EAST TEMPERATURE	83 h
	K19-5 EAST TEMPERATURE	84 j
	K20-9 LCWS SUPPLY TEMP	85 k
	K20-5 LCWS SUPPLY TEMP	86 m
	K21-9 LCWR RETURN TEMP	87 n
	K21-5 LCWR RETURN TEMP	88 p
	K22-9 CHILLER TEMPERATURE	89 r
	K22-5 CHILLER TEMPERATURE	90 s
	RAW PUMP #1 CONTACTS	91
	COMMON	92
	RAW PUMP #2 CONTACTS	93
	CHILLER PUMP #1 CONTACTS	94
	COMMON	95
	CHILLER PUMP #2 CONTACTS	96
	TB2-5 CHILLER FLOW SWITCH	97 x
	TB2-6 CHILLER FLOW SWITCH	98 y
	CHILLER PUMP #1 COIL	99
	COMMON	100
	CHILLER PUMP #2 COIL	101
	RAW PUMP #1 COIL	102
	COMMON	103
	RAW PUMP #2 COIL	104
	SURGE TANK HIGH	105 T
	SURGE TANK HIGH	106 U
	SURGE TANK LOW	107 V
	SURGE TANK LOW	108 W
	TB2-1 RAW FLOW SWITCH	109 B
	TB2-2 RAW FLOW SWITCH	110 C
	TB2-3 LCW FLOW SWITCH	111 z
	TB2-4 LCW FLOW SWITCH	112 q
	K1-6 MCR TOTAL INTERLOCK	113
	K10-6 MCR TOTAL INTERLOCK	114
	BLANK	115
	BLANK	116
	BLANK	117
	BLANK	118
	BLANK	119
	EARTH GROUND	120
	120 VAC HOT	121
	120 VAC NET	122

AMP STRIP CONNECTIONS

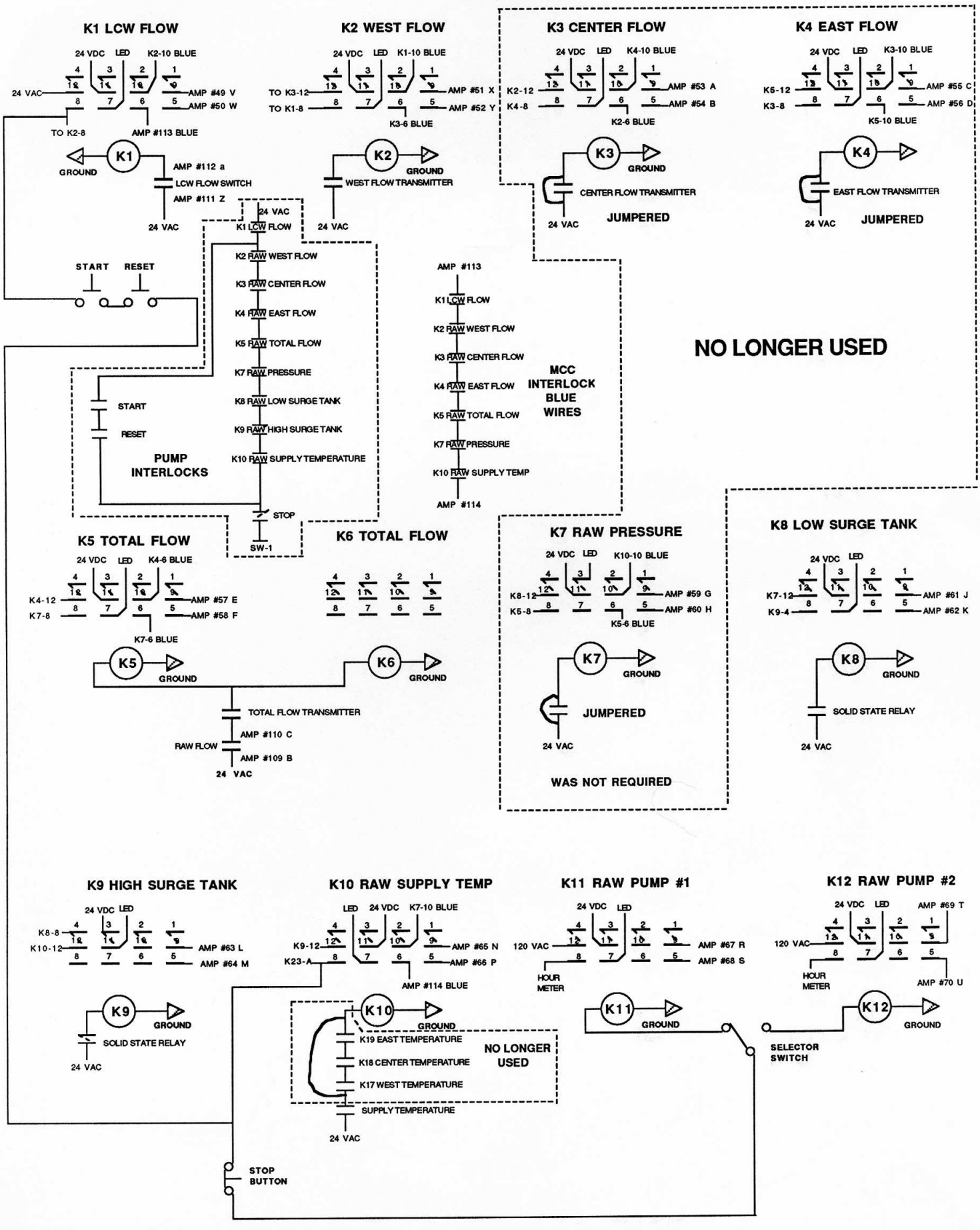
COMMON FOR TEMP	1 A
RAW TEMPERATURE	3 C
RAW RETURN TEMP	4 D
BLANK	5 E
BLANK	6 F
BLANK	7 G
BLANK	8 H
BLANK	9 J
BLANK	10 K
BLANK	11
BLANK	12
BLANK	13 G
RAW SUPPLY TEMP IN	14 H
RAW SUPPLY TEMP IN	15 J
RAW RETURN TEMP IN	16 K
RAW RETURN TEMP IN	17 E
BLANK	18 F
BLANK	19 C
BLANK	20 D
BLANK	21 A
BLANK	22 B
BLANK	23 L
BLANK	24 M
BLANK	25 N
BLANK	26 P
BLANK	27 R
BLANK	28 S
- TOTAL FLOW OUT	29 L
+ TOTAL FLOW OUT	30 M
- EAST FLOW OUT	31 N
+ EAST FLOW OUT	32 P
- CENTER FLOW OUT	33 R
+ CENTER FLOW OUT	34 S
- WEST FLOW OUT	35 T
+ WEST FLOW OUT	36 U
TOTAL FLOW INPUT	37 K
TOTAL FLOW INPUT	38 M
SHEILD	39 L
EAST FLOW INPUT	40 A
EAST FLOW INPUT	41 B
SHEILD	42 C
CENTER FLOW INPUT	43 D
CENTER FLOW INPUT	44 E
SHEILD	45 F
WEST FLOW INPUT	46 G
WEST FLOW INPUT	47 H
SHEILD	48 J
K1-9 LCW FLOW	49 V
K1-5 LCW FLOW	50 W
K2-9 WEST FLOW	51 X
K2-5 WEST FLOW	52 Y
K3-9 CENTER FLOW	53 A
K3-5 CENTER FLOW	54 B
K4-9 EAST FLOW	55 C
K4-5 EAST FLOW	56 D
K5-9 TOTAL FLOW	57 E
K5-5 TOTAL FLOW	58 F
K7-9 PRESSURE	59 G
K7-5 PRESSURE	60 H
K8-9 LOW SURGE TANK	61 J
K8-5 LOW SURGE TANK	62 K
K9-9 HIGH SURGE TANK	63 L
K9-5 HIGH SURGE TANK	64 M
K10-9 SUPPLY TEMP	65 N
K10-5 SUPPLY TEMP	66 P
K11-9 RAW PUMP #1	67 R
K11-5 RAW PUMP #1	68 S

TOTAL FLOW TRANSMITTER	EAST FLOW TRANSMITTER	CENTER FLOW TRANSMITTER	WEST FLOW TRANSMITTER
AC IN	AC IN	AC IN	AC IN
AC IN	AC IN	AC IN	AC IN
GROUND	GROUND	GROUND	GROUND
SHEILD	SHEILD	SHEILD	SHEILD
FLOW TURBINE	FLOW TURBINE	FLOW TURBINE	FLOW TURBINE
FLOW TURBINE	FLOW TURBINE	FLOW TURBINE	FLOW TURBINE
METER-	METER-	METER-	METER-
METER+	METER+	METER+	METER+
OUTPUT -	OUTPUT -	OUTPUT -	OUTPUT -
OUTPUT+	OUTPUT+	OUTPUT+	OUTPUT+

M01 RAW WIRING

Original By RED 11/11/81

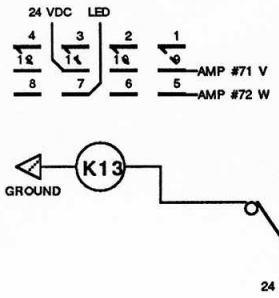
BY RED 12/12/86
Rev. 11/16/8



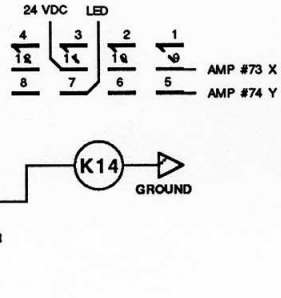
M01 RAW WIRING - 2

BY RED 12/12/86
Rev. 11/10/89

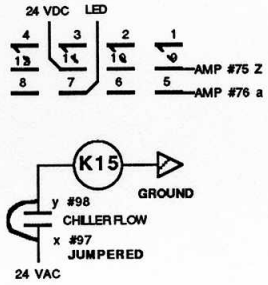
K13 CHILLER PUMP #1



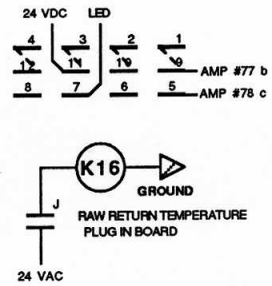
K14 CHILLER PUMP #2



K15 CHILLER FLOW

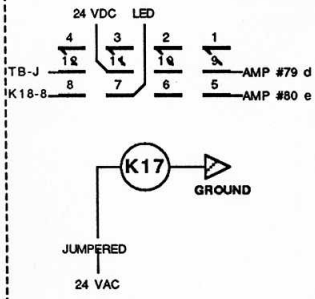


K16 RETURN TEMPERATURE

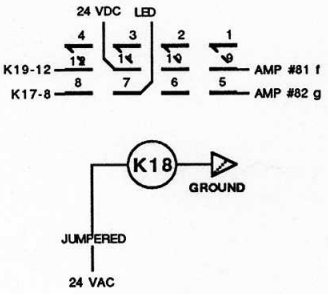


These Relays are not used.

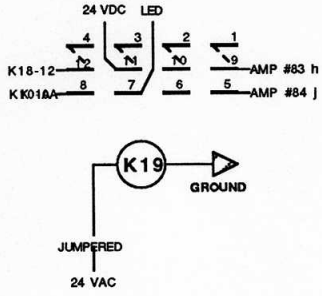
K17 WEST TEMPERATURE



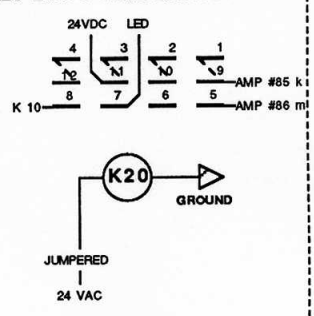
K18 CENTER TEMPERATURE



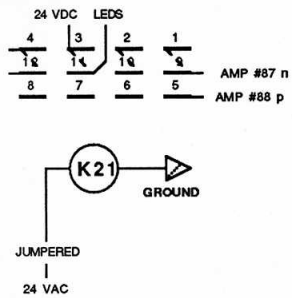
K19 EAST TEMPERATURE



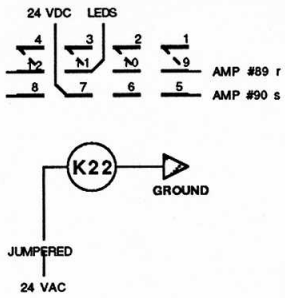
K20 LCWS TEMPERATURE



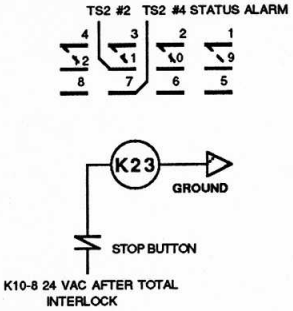
K21 LCWR TEMPERATURE



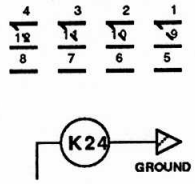
K22 CHILLER TEMPERATURE



K23 SUMMATION



K20 SPARE



M01 Main Control Box AMP Strip Connections

Rev. 11/14/89

01	Common	A	
02	RAW Pressure	B	
03	RAW Temperature	C	To Remote
04	RAW Temp Before Heat-X	D	Readouts
05	West Temperature	E	
06	Center Temperature	F	
07	East Temperature	G	
08	LCW Supply Temperature	J	
09	LCW Return Temperature	K	

Raw Temperature	G	19		
	H	20	Inputs from	
RAW Temp Before Heat Exchanger	J	21		
	K	22	System	
West Temperature	E	17		
	F	18	Interconnect	
Center Temperature	C	15		
	D	16	Box	
East Temperature	A	13		
	B	14		
LCW Supply Temperature	L	07	TB-2	
	M	08	TB-2	
LCW Return Temperature	N	09	TB-2	
	P	10	TB-2	
Chiller Temperature	R	11	TB-2	
	S	12	TB-2	

29	-Total Flow Output	L	
30	+Total Flow Output	M	
31	-East Flow Output	N	To Remote
32	+East Flow Output	P	
33	-Center Flow Output	R	Status
34	+Center Flow Output	S	
35	-West Flow Output	T	
36	+West Flow Output	U	

37	Total Flow Input	K	10	
38	Total Flow Input	M	11	Inputs From
39	Shield	L	12	
40	East Flow Input	A	01	System
41	East Flow Input	B	02	
42	Shield	C	03	Interconnect
43	Center Flow Input	D	04	
44	Center Flow Input	E	05	Box
45	Shield	F	06	
46	West Flow Input	G	07	
47	West Flow Input	H	08	
48	Shield	J	09	

49	K1 LCW Flow	V	
50	K1 LCW Flow	W	
51	K2 West Flow	X	
52	K2 West Flow	Y	To Remote
53	K3 Center Flow	A	
54	K3 Center Flow	B	Status Points
55	K4 East Flow	C	
56	K4 East Flow	D	Normally
57	K5-6 Total Flow	E	
58	K5-6 Total Flow	F	Open
59	K7 RAW Pressure	G	
60	K7 RAW Pressure	H	Contacts

61	K8 Low Surge Tank	J	
62	K8 Low Surge Tank	K	To Remote
63	K9 High Surge Tank	L	
64	K9 High Surge Tank	M	
65	K10 Supply Temperature to Dump	N	Status Points
66	K10 Supply Temperature to Dump	P	
67	K11 RAW Pump #1	R	
68	K11 RAW Pump #1	S	
69	K12 RAW Pump #2	T	
70	K12 RAW Pump #2	U	
71	K13 Chiller Pump #1	V	
72	K13 Chiller Pump #2	W	
73	K14 Chiller Pump #2	X	Normally
74	K14 Chiller Pump #2	Y	
75	K15 Chiller Flow	Z	
76	K15 Chiller Flow	a	
77	K16 RAW Temperature Before Heat	b	Open
78	K16 RAW Temperature Before Heat	c	
79	K17 West Temperature	d	
80	K17 West Temperature	e	
81	K18 Center Temperature	f	
82	K18 Center Temperature	g	
83	K19 East Temperature	h	Contacts
84	K19 East Temperature	j	
85	K20 LCW Supply Temperature	k	
86	K20 LCW Supply Temperature	m	
87	K21 LCW Return Temperature	n	
88	K21 LCW Return Temperature	p	
89	K22 Chiller Temperature	r	
90	K22 Chiller Temperature	s	

91	RAW Pump #1		
92	Common		Contacts from
93	RAW Pump #2		Starters
94	Chiller Pump #1		
95	Common		
96	Chiller Pump #2		
97	Chiller Flow Switch	x	05 TB-2
98	Chiller Flow Switch	y	06 TB-2
99	Chiller Pump #1 Coil		
100	Common		
101	Chiller Pump #2 Coil		To Starters
102	RAW Pump #1 Coil		
103	Common		
104	RAW Pump #2 Coil		

105	Surge Tank High	T	23	Input From
106	Surge Tank High	U	24	Interconnect
107	Surge Tank Low	V	25	Box
108	Surge Tank Low	W	26	

109	RAW Flow Switch	B	1 TB-2
110	RAW Flow Switch	C	2 TB-2
111	LCW Flow Switch	z	3 TB-2
112	LCW Flow Switch	q	4 TB-2
113	MCR Total Interlock		
114	MCR Total Interlock		
116	Not Used		
117	Not Used		
120	Earth Ground		
121	120 Vac Hot		
122	120 Vac Net		

GOB 22-38 PNE Connector

Amp Strip	Connector
53	A
54	B
55	C
56	D
57	E
58	F
59	G
60	H
61	J
62	K
63	L
64	M
65	N
66	P
67	R
68	S
69	T
70	U
71	V
72	W
73	X
74	Y
75	Z
76	a
77	b
78	c
79	d
80	e
81	f
82	g
83	h
84	j
85	k
86	m
87	n
88	p
89	r
90	s (center pin)

Wired from center out, Rotation Clockwise, Looking at Back Side.

M01 RAW Pumping System Interconnect Box

TB-1		
01	A	
02	B	East Flow
03	C	
04	D	
05	E	Center Flow
06	F	
07	G	
08	H	West Flow
09	J	
10	K	
11	M	Total Flow
12	L	
13	A	East Temperature
14	B	East Temperature
15	C	Center Temperature
16	D	Center Temperature
17	E	West Temperature
18	F	West Temperature
19	G	RAW Supply Temperature
20	H	RAW Supply Temperature
21	J	RAW Temperature Before Heat-x
22	K	RAW Temperature Before Heat-x
23	T	Surge Tank High
24	U	Surge Tank High
25	V	Surge Tank Low
26	W	Surge Tank Low

TB-2		
01	b	RAW Flow
02	c	RAW Flow
03	z	LCW Flow
04	a	LCW Flow
05	x	Chiller Flow
06	y	Chiller Flow
07	L	LCW Supply Temp
08	M	LCW Supply Temp
09	N	LCW Return Temp
10	P	LCW Return Temp
11	R	Chiller Temp
12	S	Chiller Temp